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Public policy discourse, planning and measures toward sustainable energy strategies in Canada ☆

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Abstract

Since the 1970s, Canada has formulated various strategy measures to accelerate the development of energy efficiency systems and renewable energy technologies and has made significant progress. ‘‘From 1990 to 2003, Canada's energy efficiency improved by an estimated 13%, or 883.3 petajoules, saving Canadians almost $13.4 billion in 2003 alone and reducing annual greenhouse gas emissions by 52.3 megatonnes’’. In 2000, about 17% of Canadian primary energy supply came from renewable sources (with hydroelectric, combustible renewables and waste). Canada is a leader in devising and implementing energy options for sustainable development. However, the nation still has great scope for furthering energy efficiency and more use of renewable energy. Canada has a higher aggregate intensity—absolute energy use per capita or per unit of GDP—than most International Energy Agency (IEA) countries, ranking second and fourth, respectively. In 2000, Canada used only a small amount of renewable energy (without hydroelectric, combustible renewables and waste), accounting for 1.3% of its primary energy supply. Canada has made little use of wind power compared to other industrialized countries. By June 2004, Canada's installed capacity was 341 megawatts (MW), compared to 13,407 MW installed by late 2003 in Germany, the country with the largest installed capacity. Canada's current small-scale hydroelectric capacity is about 2000 MW. Canada also has a few grid-connected wood-waste-fired power plants operational or under construction, with a

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maximum capacity of 60 MW. By 1999, Canada was generating 85.3 MW of electricity from captured municipal landfill gas. It is also worth noting that solar power is now finding niche applications in Canada, despite the fact that its cost remains relatively high (although falling). Canada is a signatory to the Kyoto Protocol. It has committed to reducing its emissions to 6% below 1990 levels by 2008–2012. But Canada's emissions level was already 24% above 1990 levels by 2003. As nearly 90% of all anthropogenic GHG emissions in Canada result from the production and consumption of fossil fuels, meeting the Kyoto target will challenge all Canadian governments and the energy industry to develop new and more effective strategies for speeding the development of sustainable energy to limit GHG emissions. There is an urgent need for analyzing current strategies of sustainable energy in Canada and examining the issues of these strategies. In theory and practice, however, there has so far been no a clear, integrated and comprehensive strategy framework for sustainable energy in Canada. Nor a clear definition of sustainable energy strategy was formulated. In this paper, we attempted to define sustainable energy strategy as the energy strategy aiming at improving energy efficiency and promoting renewable energy. Based on the definition above, we formulated an analytical framework for developing the strategies of sustainable energy. In the analytical framework, (1) sustainable energy strategy embraces strategic objectives, measures and management; (2) sustainable energy strategy is divided into two major groups: energy efficiency strategy and renewable energy strategy; (3) strategy measures of energy efficiency are classified as ten types; and (4) strategy measures of renewable energy are classified as four types. We have employed the framework to analyze current strategic objectives, strategic measures and policy and management strategies concerning sustainable energy in Canada and examine the issues of these strategies.

Keywords: Sustainable energy strategies; Energy efficiency; Renewable energy; Canada

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1. Introduction

Canada is a country with very rich non-renewable sources of energy and has been a net exporter of oil, gas and coal for a long time. Canada had a reported 178.8 billion barrels of proven oil reserves in 2005, second only to Saudi Arabia. In 2004, Canada produced 3.1 million barrels per day (bbl/d) and exported 0.8 million bbl/d. The proven natural gas reserves, 56.1 trillion cubic feet (Tcf) as of January 2005, rank 19th in the world. In 2002, Canada produced 6.6 Tcf of natural gas, the third-highest level in the world behind Russia and the United States and exported 3.6 Tcf. Canada holds an estimated 7.3 billion short tons of recoverable coal reserves and in 2002, Canada a total of 73.2 million short tons (Mmst) were produced and exported over half its coal production [1].

Canada, however, still faces the challenge to make a transition to sustainable energy use patterns in order to save fossil fuels for future generations and to reduce the negative impacts of burning fossil fuels on the environment. Canada is becoming increasingly reliant on greenhouse intensive fuels for their energy. The most dominant fuel source in this country is brown coal, which is used for electricity generation. Oil comprises 30% of the fuels used in Canada and is primarily used for transportation. Natural gas comprises 19% of the fuels used and is used for both electricity generation and directly in homes and businesses for heating and cooking. According to EIA, Canada consumed 13.1 quadrillion British thermal units (Btu) of total energy and emitted 592 million metric tons (Mmt) of carbon dioxide from energy production in 2002. Per capita energy consumption (418 million Btu) and per capita carbon dioxide emissions (18.9 mt) of Canada were some of the highest amongst the 25 member of the organization for economic co-operation and development (OECD). Canada had the third-most energy-intensive and the fourth-most carbon-intensive economy in the OECD due to its heavy reliance on energy-intensive industries. Canada is a signatory to the Kyoto Protocol and has committed to reducing its emissions to 6% below 1990 levels by 2008–2012. But Canada's emissions were already 24% above 1990 levels by 2003 [2]. Unless the country takes new strategy measures, Canada will actually have to reduce emissions by at least 26% from their forecast levels to meet the Kyoto target [3]. As nearly 90% of all anthropogenic GHG emissions in Canada result from the production and consumption of fossil fuels, the most important ways for Canada to meet the Kyoto target are using energy more efficiently and establishing a more sustainable mix of energy sources, which means a greater reliance on renewable sources. In other words, Canada should speed up the development of a sustainable energy strategy in order to meet the Kyoto target.

The question is how to speed up the development of sustainable energy. Strategies are very important. Many studies have found that the development of renewable energy and energy efficiency methods requires a coherent supportive strategies framework that serves to create a level playing field for renewable energy and energy efficient systems (REES). Clear political commitment for promotion of REES should be translated into supportive strategies that provide incentives for REES and tilt the playing field in their favour. Targets and timetable for implementation of REES can also play a useful role in signaling long-term political commitment and greater certainty for investors [4].

Since the 1970s, Canada has formulated various strategy measures to accelerate the development of energy efficiency systems and renewable energy technologies [5] and has made significant progress. "From 1990 to 2003, Canada's energy efficiency improved by an estimated 13%, or 883.3 petajoules, saving Canadians almost $13.4 billion in 2003 alone

and reducing annual greenhouse gas emissions by 52.3 megatonnes'' [6]. In 2000, 16.8% of Canadian primary energy supply came from renewable sources (with hydroelectric, combustible renewables and waste) [7]. Canada is a leader in devising and implementing energy options for sustainable development [8]. Canada, however, has still great scope for further energy efficiency and more use of renewable energy. Canada has a higher aggregate intensity—absolute energy use per capita or per unit of GDP—than most International Energy Agency (IEA) countries, ranking second and fourth, respectively (see Table 1) [9]. In 2000, Canada used only a small amount of renewable energy (without hydroelectric, combustible renewables and waste), accounting for 1.3% of its primary energy supply [10]. So far, Canada has made little use of wind power compared to other industrialized countries. By June 2004, Canada's installed capacity was 341 MW [11], compared to 13,407 MW installed by late 2003 in Germany [12], the country with the largest installed capacity. Canada's current small-scale hydroelectric capacity is about 2000 MW [13].

Canada also has a few grid-connected wood-waste-fired power plants operational or under construction, with a maximum capacity of 60 MW [14]. By 1999, Canada was generating 85.3 MW of electricity from captured municipal landfill gas [15]. ''It is also worth noting that solar power is now finding niche applications in Canada, despite the fact that its cost remains relatively high (although falling)'' [16]. It is very obviously that meeting the Kyoto target will challenge all Canadian governments and the energy industry to develop new and more effective strategies for speeding the development of sustainable energy to limit GHG emissions [17].

There is an urgent need for analyzing current strategies for sustainable energy in Canada and examining the issues of these strategies in order to develop new and more effective strategies for speeding up the development of sustainable energy use systems in Canada. In theory and practice, however, there has so far been no a clear, integrated and comprehensive strategy framework for sustainable energy use in Canada. Nor a clear definition of sustainable energy strategy was formulated. In the Section 2 of this paper, we attempted to define sustainable energy strategy to improve on energy efficiency and promote renewable energy. Based on the definition above, we develop an analytical framework for formulating a strategy for sustainable energy use systems. In the analytical framework, (1) sustainable energy strategy embraces strategic objectives, measures and management strategies; (2) sustainable energy strategy is divided into two major groups: energy efficiency strategy and renewable energy strategy; (3) strategy measures of energy

Table 1
Energy intensities for selected IEA countries

Gigajoules per capital		*Gigajoules per* $1000 *of GDP*	
Luxembourg	355.7	Czech Republic	18.8
Canada	249.2	Hungary	13.2
United States	225.6	Turkey	11.4
Finland	203.6	Canada	10.8
Norway	196.4	Korea	8.5
Belgium	175.4	New Zealand	8.1
Sweden	164.0	United States	7.2
Netherlands	157.3	Australia	6.5
Australia	157.0	Finland	6.3
New Zealand	149.3	Portugal	6.3

efficiency are classified 10 types; and (4) strategy measures of renewable energy are classified as four types. We employ the framework to analyze current strategic objectives, strategy measures and strategy management of sustainable energy in Canada. Section 3 examines the main issues of these strategies for sustainable energy in Canada. Section 4 concludes.

2. Current sustainable energy strategies in Canada

Energy crises during the 1970s and the ever-increasing pressure on the environment have turned Canada's attention to the need for a sustainable energy strategy. Canada has formulated various strategy measures to accelerate the development for energy efficiency methods and renewable energy technologies. The strategy measures of energy efficiency are classified as the following 10 types:

(1) Assessment/monitoring.
(2) Auditing/benchmarking.
(3) Fiscal/financial/tariffs.
(4) Information/education/motivation.
(5) Labelling.
(6) Mandates/standards.
(7) Institutional framework.
(8) R&D/technology procurement.
(9) Third party financing.
(10) Voluntary agreements.

The strategy measures of renewable energy are classified as the following four types:

(1) Regulatory strategies and government mandate.
(2) Economic incentives.
(3) R&D support.
(4) Market development.

2.1. *Strategic objectives concerning energy sustainability*

Suitable strategic objectives are very important for the development of energy sustainability in Canada. Strategic objectives of sustainable energy development in Canada, a critical part of the national development strategy, include two categories: strategic objectives of energy efficiency and strategic objectives of renewable energy. The strategic objectives of sustainable energy are reflected in various development strategies of the governments of Canada or the departments of the governments during different time periods and the emphasis among these strategic objectives has varied.

In the 1970s and early 1990s the focus of the strategic objectives of sustainable energy in Canada was on improving energy efficiency systems. In the mid- to late-1970s, the Government of Canada undertook a policy to advocate and promote changes to behavior and lifestyle to reduce the consumption of energy through encouraging people to turn down their thermostats and to turn off unnecessary lighting, etc. In the late 1970s and early 1980s, federal government spending on energy efficiency programs grew significantly. It

used grant programs, such as the Canadian Home Insulation Program (CHIP), to convince energy users to become more energy-efficient. By the mid-1980s, with energy prices declining and energy supplies increasing, the federal government redirected its focus to promoting energy efficiency through R&D, market-based research, demonstration projects and activities to provide information. By the late 1980s, there was a growing concern worldwide about the burning of fossil fuels, the associated greenhouse gas emissions and their impact on global climate change. As a result of such concern and other environmental issues, the federal government began, in the early 1990s, to re-emphasize improving energy efficiency. It has promoted a wiser use of energy without sacrificing its benefits or requiring major changes in lifestyle. For example, people are encouraged to buy more energy-efficient furnaces and to buy light bulbs that produce about the same light with less energy.

On 1 January 1993, the Energy Efficiency Act came into effect. The Act enables NRCan to make and enforce regulations on the energy efficiency of products that use energy and to promote energy efficiency and energy from alternative sources. NRCan now regulates minimum levels of energy performance for more than 20 products that use energy. These products, such as stoves and refrigerators, account for 65% of overall use of energy in homes [18]. Beginning in the mid-1990s the strategic objectives of sustainable energy are no longer narrowly concerned with energy efficiency methods and start to emphasize the development of renewable energy technologies. In 1996, the Government of Canada developed the Renewable Energy Strategy, a blueprint for cooperative action with stakeholders to accelerate the development and, in particular, the commercialization of emerging renewable sources. In 1998, the Renewable Energy Deployment Initiative was set up to encourage the development of markets for cost-effective renewable heating and cooling systems.

Two years later, the Government of Canada Action Plan 2000 on Climate Change contained several new strategies that target the development of markets for promising, emerging renewable electricity sources, including the following:

(1) to purchase 20% of the Government of Canada's electricity requirements from emerging low- or non-emitting sources;
(2) to provide a financial incentive to emerging renewable energy distributors to stimulate sales in residential and small-business markets;
(3) to install emerging non-GHG-emitting technologies at government facilities; and
(4) to work with interested jurisdictions on access to electricity grids for low- and non-emitting generation.

1n 2002, federal government's Climate Change Plan for Canada sets the target of at least 10% of new electricity generating capacity in Canada to come from emerging renewable sources [19].

Provincial and territorial governments of Canada also set their strategic objectives of renewable energy. Their current strategic objectives for renewable energy are presented in Table 2.

2.2. Strategy measures for energy sustainability

2.2.1. Strategy measures of energy efficiency

Both the federal and provincial governments have adopted a variety of strategy measures to promote energy conservation and energy efficiency for many years. Main strategy measures for energy efficiency systems of the federal government, and provincial

Table 2
Strategic objectives of renewable energy of Provincial and Territorial Governments of Canada

Alberta	The goal of the government is to increase renewable and alternative energy portion of total provincial energy capacity by 3.5% by 2008 [20]
British Columbia	In its energy plan the government of British Columbia sets a voluntary goal for electricity distributors (BC Hydro and Fortis) to acquire 50% of new supply between 2002 and 2012 from "BC Clean Electricity" [21]
New Brunswick	New Electricity Act, which comes into effect in October 2004 and gives the government power to implement a mandatory renewable portfolio standard [22]
Northwest Territories	Medium and long-term targets of the government are to provide 10% of the energy supplied to our communities (excluding industrial energy supply) from renewable energy sources by 2010 and 25% by 2025 [23]
Nova Scotia	A mandatory renewable portfolio standard will be implemented in 2006. The EMGC recommended that the standard should require that, by 2010, green power from facilities installed post-2001 should represent 3.2% of electrical energy supplied [24]
Ontario	Short-term and medium-term targets of the government are to generate 5% of Ontario's total energy capacity from renewable sources by 2007, and 10% by 2010 [25]
Prince Edward Island	To implement a mandatory renewable portfolio standard of at least 15% by 2010 (representing 40 MW of wind capacity over and above currently existing facilities), and to "evaluate opportunities for having 100% of [the Island's] electrical capacity acquired by renewable energy by 2015" [26]
Québec	The government's goal is to adopt a regulation to mandate the installation of 1000 MW of wind power capacity by the end of 2012 and to require the installation of 100 MW of biomass-fired electricity capacity by 2010 [27]
Saskatchewan	The government's goal is to implement a new Green Power Portfolio of initiatives to meet load growth over the next several years without creating new GHG emissions [28]. The Portfolio contains two green power development initiatives: the first is a partnership between SaskPower and ATCO Power to construct a 150 MW wind farm at Rushlake Creek. Under the second initiative, SaskPower is issuing an annual Request for Proposals (RFP) for up to 15 MW of Environmentally Preferred Power in 2003/2004, 2004/2005 and 2005/2006 [29]

and territorial governments of Canada are presented in Tables 3 and 4, respectively [30]. As Tables show, some of the adopted strategy measures are implemented in specific sectors. Other strategy measures are directed at equipment that is found in many sectors. Most of them, in particular, are the integrated strategy measure which a number of strategy measures are combined to create a strong overall energy efficiency measure that addresses a variety of needs. The experience indicates that the most effective way to improve energy efficiency is the integrated strategy measure, for example, the Canadian industry program for energy conservation (CIPEC). The CIPEC is an integrated strategy measure and is based on voluntary, collective targets for each industrial sector. This strategy integrates the following components:

(1) Targets.
(2) Reporting/benchmarking: annual measuring and reporting; industry mean and best practice.

Table 3
Main strategy measures of energy efficiency of Canadian Federal Government

Name	Type	Sector	Description
Canadian industry program for energy conservation (CIPEC)	Integrated measure: Targets Reporting/benchmarking Benchmarking Audits/assessments	Industry	The CIPEC is based on voluntary, collective targets for each industrial sector. Under the measure, the sector tasks forces identify energy efficiency opportunities, review and address the barriers associated with these opportunities, and develop and implement strategies for realization of the opportunities. The measure includes annual measuring and reporting by industry participants. Benchmarking is conducted in which facilities are compared to the industry mean as well as to a ‘‘best practice’’ which is defined as the top quartile
EnerGuide for appliances and equipment	Integrated measure: Information/education/motivation Labelling	Residential	This measure is mandatory for new products and gives a comparative assessment of energy efficiency and energy consumption for a range of appliances on the market, which complements the minimum efficiency standards, seeks to stimulate consumer awareness and to influence purchasing decisions. It covers household appliances and air conditioners
Federal buildings initiative (FBI)	Integrated measure: Auditing/benchmarking Information/education/motivation Third party financing Voluntary agreements	Public	This measure aims to facilitate comprehensive energy efficiency upgrades and building retrofits for departments, agencies and Crown corporations of the Government of Canada, through mechanisms such as public-private partnerships with energy management firms. The FBI supports partnerships with energy management firms that provide a turnkey service that includes engineering, third-party private-sector financing, comprehensive training packages and performance guarantees
EnerGuide for houses	Integrated measure: Information/education/motivation Labelling	Residential	This strategy measure persuades and assists homeowners to make energy efficiency improvements in their houses and home buyers to consider energy efficiency in their purchase decisions. The Government of Canada partly subsidizes the cost of the evaluation. Grants are available to partially offset the costs of the energy-efficiency improvements. The amount of the grant depends on the difference between the EnerGuide for Houses rating before and after the retrofits

Commercial building incentive program (CBIP)	Integrated measure: Fiscal/financial/tariffs Information/education/motivation	Commercial and public	This strategy measure provides financial incentives to builders and developers to incorporate energy-efficient technologies and practices into the design and construction of new commercial, institutional and multi-unit residential buildings. To qualify for the incentive, buildings must be at least 25% more efficient than buildings that meet the requirements of the Model National Energy Code for Buildings (MNECB). CBIP provides a one-time grant equal to twice the difference in estimated annual energy costs between an approved CBIP design and an MNECB design, up to a maximum of $80,000
Action Plan 2000 on climate change	Integrated measure: Policy/institutional framework Assessment/monitoring	Corsscutting	This strategy measure takes action on many fronts, including expanding the use of low- or non-emitting energy sources; increasing the use of ethanol in gasoline; investing in the refuelling infrastructure for fuel cell vehicles; direct support of new technologies and development of technology networks; study of energy efficiency and early application of sustainable energy technology in remote (non-grid) communities; and analyzing strategy options such as domestic emissions trading
Energy innovators initiative (EII)	Integrated measure: Auditing/benchmarking Fiscal/financial/tariffs Information/education/motivation Third party financing Voluntary agreements	Commercial and public	This strategy measure promotes energy efficiency upgrades and building retrofits in the commercial and institutional sector. The EII provides a wide range of products and services to help organizations plan, finance and implement comprehensive energy efficiency improvements
Voluntary agreement on fuel efficiency of vehicles	Integrated measure: Voluntary agreements Information/education/motivation Labelling	Transport	This strategy measure aims to promote consumer purchase decisions towards more fuel-efficient vehicles through the use of the EnerGuide for Vehicles label and the Fuel Consumption Guide developed by Natural Resources Canada
Industrial building incentive program (IBIP)	Integrated measure: Fiscal/financial/tariffs Information/education/motivation	Industry	The IBIP is adopted to increase the energy efficiency of newly constructed buildings used for manufacturing and other industrial activities. The IBIP offers an incentive, primarily in the form of information programming, to companies building new industrial facilities to offset additional design costs inherent in the initial attempts at energy-efficient design

Table 3 (*continued*)

Name	Type	Sector	Description
Energy ratings system for industry program	Integrated measure: Assessment/monitoring Labelling Information/education/motivation	Industry	This strategy measure aims to put the principles and lessons learned from the long-standing EnerGuide for Appliances labelling and rating program to work in industrial equipment markets. The strategy measure provides and promotes the information and assessment tools required for industrial energy managers, procurement and financial officers and plant engineers to include energy efficiency in their buying decisions
Doubling of green municipal funds	Integrated measure: Fiscal/financial/tariffs Assessment/monitoring	Public	To stimulate investment in innovative municipal infrastructure projects and environmental practices or Canadian municipal governments and their public and private-sector partners. The Government of Canada established two complementary funds to stimulate investment in innovative municipal infrastructure projects and environmental practices by Canadian municipal governments and their public and private-sector partners
Cross-cutting measures for industry	Integrated measure: Policy/institutional framework Auditing/benchmarking Information/education/motivation Assessment/monitoring	Industry	The strategy measure (1) expands the industry organization, which has already reduced emissions among its members to 2% below 1990 levels, to include the electricity generation, construction, forestry and upstream oil and gas sectors; (2) helps companies to assess their energy efficiency and GHG emissions relative to comparable operations; (3) improves the industrial portion of the National Energy Use Database, which encourages industry to pursue activities related to climate change and helps the Government of Canada pinpoint promising areas for reducing emissions; (4) extends and enhances the Industrial Energy Innovators Initiative to help companies and individual organizations better deal with barriers to energy efficiency and emissions management programs; (5) provides supporting energy efficiency audits: financial assistance and guidance to companies to conduct on-site industrial audits to identify opportunities for energy efficiency; (6) makes small and medium-sized enterprises aware of the benefits of reducing GHG emissions and provides them with tools, such as customized energy management workshops, technical support, guidebooks and videos to achieve reductions

Marketing of efficient vehicles	Integrated measure: Information/education/motivation Labelling	Transport	This strategy measure is taken to encourage and assist motorists to buy, drive and maintain their vehicles in energy-efficient ways
Commercial transportation energy efficiency and fuels Initiative	Integrated measure: Information/education/motivation Fiscal/financial/tariffs	Industry	This strategy measure is adopted to increase the market penetration of efficiency enhancing technologies, including anti-idling devices, in all modes. Technical workshops, training programs, and publications on preventive maintenance, fuel management practices, and better informed modal choice are also part of this initiative
Reducing greenhouse gas emissions from off-road vehicles and equipment	Integrated measure: Information/education/motivation Labelling	Transport	This strategy measure provides information (through product labeling, specification sheets, fuel efficiency guides, operator training, fleet programs, public awareness campaigns, or other possible mechanisms) to help Canadians make energy efficient choices in purchasing and operating off-road vehicles and equipment, such as lawn mowers, all-terrain vehicles, agricultural machinery, powerboats, and construction equipment
Efficiency standards for equipment and appliances	Mandates/standards	Residential, commercial and industry	Canada's Energy Efficiency Act authorizes minimum energy efficiency standards to phase out less efficient energy-using equipment and household appliances from the Canadian marketplace. The first regulations under the Act came into force on 3 February 1995. To date, regulations have been established for more than 30 products, including residential energy-using products, electric motors and lighting products. Regulations apply to products that account for over 75% of residential energy demand. Federal regulations apply to imported products and products traded between provinces. Provincial regulations—implemented in Ontario (1988), British Columbia (1990), Quebec (1992), Nova Scotia (1991) and New Brunswick (1995)—apply to intra-provincial sales or leases
Model national energy code for new residential and commercial buildings (MNECRCB)	Mandates/standards	Commercial and residential	The MNECRCB consists of two parts, namely the Model National Energy Code for Houses and the Model National Energy Code for Buildings. The MNECRCB aims to increase energy efficiency by specifying minimum performance standards for new Canadian houses and buildings. It provides this customized energy standard by allowing for regional climate and energy and construction cost variations

Table 3 (*continued*)

Name	Type	Sector	Description
Motor vehicle fuel efficiency program	Voluntary agreements	Residential	The measure aims to promote improvements in new vehicle fuel efficiency by encouraging motor vehicle manufacturers to meet voluntary annual company average fuel consumption targets for new automobiles sold in Canada
Freight efficiencies and technologies initiative	Voluntary agreement	Transport	This measure aims to increase the freight transportation industry's participation in voluntary climate change initiatives by: increasing the operating efficiency and environmental training and awareness among freight operators and shippers; and demonstrating and encouraging the take-up of innovative environmental technologies and best practices within the freight transportation sector
Energy efficient housing initiative	Institutional framework	Residential	This measure aims to promote the construction and purchase of more energy-efficient, environmentally responsible housing and the energy-efficient renovation of existing housing. It encompasses two programs: the R-2000 Home Standard for builders and the EnerGuide for Houses program for home-owners and other participants in the housing market
Extension of the manufacturing tax credit	Fiscal/financial/tariffs	Industry	To encourage increased cogeneration and district heating, the manufacturing and processing (M&P) tax credit was extended to corporations that produce, for sale, steam for uses other than the generation of electricity
Adjustment to the capital cost allowance system	Fiscal/financial/tariffs	Industry and Transport	The Capital Cost Allowance (CCA) system was adjusted to encourage investment in energy efficient equipment. It includes: an increase in the CCA rate for certain railway assets from 10% to 15% an extension of the separate class election to include manufacturing and processing equipment; and an increase in the CCA rates from 4% to 8% for electrical generating equipment (other than buildings and other structures), and for production and distribution equipment (other than buildings and other structures) of water or heat
Building energy technology	R&D/technology procurement	Residential	To establish an industry capacity which allows a 50% improvement in energy performance in buildings. The program focusses on technology development and market acceptance and adoption for new and retrofit applications

Centre for research in cleaner manufacturing	R&D/technology procurement	Industry	To develop scientific and engineering platforms for evaluating and guiding innovation in clean, commercially viable technologies and production processes, including those that help reduce greenhouse gas emissions
Advanced energy technologies for high temperature processes	R&D/technology procurement	Industry	To conduct R&D on coke-making and pulverized coal injection on behalf of Canadian coal and steel producers. Activities include improving the energy efficiency of the iron making process, supercoke, extending coke oven life, mineral additions to improve coke quality and pulverised coal injections. Computer modelling capabilities for blast furnace optimization are also developed
Gas turbine research project	R&D/technology procurement	Industry	In 2000, the Canadian government announced a C$53 million loan to Rolls-Royce Industries Canada Inc. for a research project on more efficient industrial gas turbines technologies
Technology and innovation initiative	R&D/technology procurement	Industry, commercial, public and transport	The Technology and Innovation Initiative (funded at $250 million in Budget 2003) contributes to the development, demonstration and early adoption of new, cleaner technologies and economic opportunities. The Initiative focuses on five areas critical to achieving climate change goals: hydrogen economy, cleaner fossil fuels, advanced end-use efficiency technology, decentralized energy and biofuels
R-2000 Home program	Information/education/motivation	Residential	To encourage Canadians to build houses that meet minimum voluntary standards for windows and doors, insulation, HVAC (heating, ventilation and air conditioning), lighting systems, air quality, recycled materials and water conservation. Certified R-2000 new houses are up to 50% more efficient than homes built to current building codes. R-2000 targets home building companies through education and training schemes
Federal vehicles initiative (FVI)	Information/education/motivation	Transport	To target federal vehicle fleets to reduce energy use and promote the use of alternative transportation fuels. The objectives of the initiative are to: improve the operational efficiency of fleets; reduce greenhouse gas emissions from fleets; and accelerate the use of alternative transportation fuels. The initiative provides fleet managers with an assessment of fleets at little or no cost and technical advice on using alternative transportation fuels (ATFs) and acquiring alternative fuel vehicles

Table 3 (*continued*)

Name	Type	Sector	Description
Personal vehicles initiative (PVI)	Information/education/motivation	Transport	To encourage and assist motorists to buy, drive and maintain their vehicles in energy-efficient ways that save fuel and money, and emphasizes how such efforts also reduce vehicle emissions. Its main tool is the AutoSmart Guide, which offers information and tips on purchasing, operating and maintaining personal vehicles. The program also provides resource materials to driver educators for fuel-efficiency training to novice drivers and provides Web-based communications tools that support and encourage the development of new initiatives of local governments, industry and associations to promote fuel efficiency
Fleet vehicles program (FVP)	Information/education/motivation	Transport	To encourage Canadian commercial fleet operators to reduce operating costs through energy-efficient practices and the use of alternative fuels. FVP provides information materials, workshops, technical demonstrations and training programs to help fleet operators assess opportunities to increase energy efficiency in their operations
Training program "smart driver for forestry trucks"	Information/education/motivation	Transport	Natural Resources Canada announced in September 2000 a training program "Smart Driver for Forestry Trucks" to improve the fuel efficiency for the forest trucking industry
Aboriginal and northern community action program (ANCAP)	Information/education/motivation	Residential, commercial and public	Aboriginal and northern communities rely on diesel generation to improve their energy efficiency and adopt alternative energy sources to reduce their dependence on diesel fuel
Program to help municipalities	Assessment/monitoring	Public	The Canadian federal budget 1999 provided $1.6 million over 3 years to help the Federation of Canadian Municipalities initiate a program to help municipalities identify opportunities for energy savings in their operations

Table 4
Main strategy measures of energy efficiency of Provincial and Territorial Governments of Canada

Ontario Electricity Pricing, Conservation and Supply Act	Integrated measure	Industry, public, commercial and residential	This provincial strategy measure integrates the following components: (1) energy conservation in government operations; (2) energy self-sufficient government buildings (for newly built buildings); (3) tax breaks for energy-efficient equipment; and (4) retail sales tax rebate for efficient appliances
Yukon Municipal Energy Solutions Partnership	Integrated measure: Voluntary agreements Auditing/ benchmarking Fiscal/financial/ tariffs	Public	The partnership aims to help municipalities implement new energy efficiency and sustainable energy initiatives
Power Smart new home program in British Columbia	Integrated measure: Information/ education/motivation Fiscal/ financial/tariffs	Residential	In British Columbia, BC Hydro has taken the strategy measure to encourage developers to install energy-efficient technologies or Power Smart Packages in new home developments
New Ontario Centre of Excellence for Electricity and Alternative Energy Technology	Integrated measure: R&D/ technology procurement Information/education/motivation	Industry, public, commercial and residential	The Government of Ontario contributes $20 million to establish a new Centre of Excellence for Electricity and Alternative Energy Technology. The centre coordinates applied research and commercialization projects for more efficient and environmentally friendly energy technologies, as well as developing applied energy technology education initiatives
Energy efficiency in buildings mandated in Saskatchewan	Mandates/standards	Public	Under this strategy, all new projects and relevant renovations with at least 30% government funding are designed and built to a high-energy performance standard. That standard is defined as at least 25% better that the Model National Energy Code for Buildings 1997. Meeting this standard helps projects qualify for the Commercial Building Incentive Program of Natural Resources Canada, which provides incentives equal to double the annual energy savings, to a maximum of $60,000 for commercial buildings and $80,000 for industrial buildings

Table 4 (*continued*)

Efficiency Manitoba	Integrated measure: Information/education/motivation Fiscal/financial/tariffs	Public, commercial and residential	The Government of Manitoba created a new one-stop agency, "Efficiency Manitoba", to promote conservation of energy and resources in the province in 2003. The new agency is responsible for coordinating and consolidating all energy efficiencies including electricity and natural gas as well as water conservation, waste minimization and transportation demand management programs
Rebate on new energy efficient appliances	Fiscal/financial/tariffs	Residential	To encourage consumers to reduce their energy usage, making smart choices that benefit both the economy and the environment
Manitoba hydro lowers interest rate on power smart loans	Fiscal/financial/tariffs	Residential	To encourage more Manitobans to conserve and become more energy efficient, Manitoba Hydro lowered the interest rate on Power Smart loans, including geothermal heat pumps, from 8.5% to 6.5%. Manitoba Hydro is also working to enhance the Power Smart program by ensuring that the home energy efficiency initiatives complement existing programming

(3) Benchmarking.
(4) Audits/assessments: analysis of energy efficiency opportunities.

There are more than 25 sector tasks forces representing more than 40 industrial associations and more than 5000 companies. Under the program, the sector tasks forces identify energy efficiency opportunities, review and address the barriers associated with these opportunities, and develop and implement strategies for realization of the opportunities. The program includes annual measuring and reporting by industry participants. Benchmarking is conducted in which facilities are compared to the industry mean as well as to a ''best practice'' which is defined as the top quartile. The companies of this program have reduced their combined energy intensity by 8.7% between 1990 and 2003, or an average of 0.7% per year. Improved energy management enabled Canadian industry to avoid approximately $3.4 billion in purchased energy in 2003, enough energy to meet the energy required to heat 4.8 million Canadian households for 1 year [31].

2.2.2. Strategy measures concerning renewable energy

The Canadian governments have also aided the development of renewable energy technologies, market and projects through a variety of strategy measures for over 20 years. Major strategy measures taken to encourage the investment to tap energy from renewable energy sources include regulatory strategies and government mandate (provincial and territorial governments), economic incentives, R&D support, and market development.

Main strategy measures of renewable energy of the federal government are described as follows.

2.2.2.1. Economic incentives. The Class 43.1 accelerated capital cost allowance rate and Canadian Renewable and Conservation Expenses (CRCE) were introduced in the 1996 federal budget to promote energy efficiency and small- to medium-scale renewable energy through the income tax system [32]. The Income Tax Act contains the only non-R&D program initiated in the 1980s that is still in existence today. It is an accelerated capital cost allowance for certain renewable energy assets. The federal Income Tax Act allows taxpayers an accelerated write-off at up to 30% per year of equipment generating electricity from wind, hydro (less than 50 MW capacity30), biomass (municipal waste, wood waste, landfill gas and anaerobic digester biogas), solar PV (over 3 kW), geothermal and certain cogeneration systems. The Income Tax Act also allows the first, exploratory wind turbine of a wind farm to be fully deducted in the year of its installation, in a manner similar to the one in which the first, exploratory well of a new oil field can be written off. The eligibility has been broadened to include certain fixed-location fuel cells and ancillary fuel reformation and electrolysis equipment acquired after 18 February 2003 [33].

Beginning in 1998, the federal government provided $20 million annually for 3 years to promote investments in renewable energy and energy efficiency. This provision included an allocation of $12 million over the 3 years for the Renewable Energy Deployment Initiative to stimulate demand for renewable energy systems that heat and cool space and water in the private sector and in federal facilities. Also starting in 1998, the government provided $50 million a year over 3 years for climate change initiatives to build momentum toward concrete action and results for investments in renewable energy and energy efficiency. The February 2000 Budget announced that this support will be extended for another 3 years at $70 million each year[34]. In Budget 2005, and subsequently in Canada's climate change

plan, Project Green, the Federal government announced a renewable power production incentive (RPPI) to stimulate the installation of up to 1500 MW of new renewable energy electricity generating capacity, other than wind. An incentive payment of 1 cent per kw-h of production for the first 10 years of operation will be introduced for eligible projects commissioned after 31 March 2006 and before 1 April 2011. Budget 2005 provided $97 million over the next 5 years and a total of $886 million over 15 years for the RPPI [35].

2.2.2.2. R&D support. The Government of Canada supports renewable energy by establishing R&D strategy and plan for the renewable energy industry and funding many R&D projects directly. R&D initiatives include the following three major areas:

(1) Support various renewable energy research institutes and research projects.
(2) Target specific technologies for improvement and provide necessary training.
(3) Subsidize renewable energy demonstration projects.

Main programs related to R&D initiatives are as follows [36]:

2.2.2.3. Program of Energy Research and Development (PERD). The PERD was established in 1974. The majority of federal funding for technology initiatives for renewables originates from PERD. Under the program, CAN$5 million are invested annually in R&D related to renewable energy technologies.

2.2.2.4. Climate change action fund—technology early action measures (TEAM). Under its climate change initiatives, in 1999 the government announced several programmes in support of renewable energy technology development and demonstration. The main program for R&D is technology early action measures (TEAM), under the Climate Change Action Fund. The program funds technology projects that promise to reduce GHG emissions, nationally or internationally, while sustaining economic and social development. The program aims to help accelerate the demonstration and commercial deployment of new technologies including renewable energy technology. Proposed projects must be sponsored and co-funded by government R&D programs.

2.2.2.5. Climate change technology and innovation. 1n 2003, the government established the Climate Change Technology and Innovation to help industry meet climate change targets, as well as lay the foundation for new, cleaner technologies and economic opportunities. Those areas related to renewable energy technologies include:

Hydrogen economy: To build knowledge and accelerate the development and commercialization of fuel cells and other technologies that will form the basis of the emerging hydrogen economy, including technologies to produce hydrogen from renewable energy sources. Investments will be available to support public and private sector partnerships to develop and demonstrate hydrogen technologies and infrastructure in integrated, real-world settings. Taken together, these investments will build on Canada's first-mover advantage internationally and ensure it remains at the forefront of the transition to the hydrogen economy.

Decentralised energy: To develop and demonstrate the production systems of decentralized energy. These systems make more efficient use of locally available energy resources and renewable sources such as wind, solar and landfill gas. They can be used in

residential, commercial and industrial applications and in combined heat and power applications.

Biotechnology: To support the development and demonstration of bio-based energy systems and technologies. This covers a broad range of technologies, including biomass and waste conversions; cellulosic ethanol from biomass and other biofuels; bio-processes; biomass production, harvesting and transportation; and energy from biomass. This investment is complemented by investment in biodiesel technologies.

2.2.2.6. Market development. In order to create viable green power markets, the federal government buys some of its electricity from emerging renewable energy sources (ERES). In December 1997, NRCan began purchasing electricity from ERES from ENMAX, Calgary's electric system. The 10-year agreement with ENMAX is for the production of 10,000 MW h of electricity from renewable sources for NRCan's Alberta facilities. Environment Canada also signed an agreement with ENMAX for 2000 MW h of green electricity for their electricity requirements in Alberta.

In September 2000, NRCan signed a 10-year agreement with SaskPower, Saskatchewan's electric utility, and is receiving about 32,000 MW h annually of wind power for its facilities in Saskatchewan. Early in 2001, NRCan signed an agreement with Maritime Electric from Prince Edward Island for purchasing electricity from ERES. This 10-year agreement is for the production of 13,000 MW h annually of wind power. On the other hand, in the Action Plan 2000 on Climate Change the federal government established the Market Incentive Program (MIP) as a complement of the measure above. One of the goals of the MIP is to encourage electricity distributors to experiment with projects to stimulate sales of electricity from ERES to their residential and small business customers. Funding is available through the MIP until 31 March 2006. As a result of these measures, and on the continued momentum in the marketplace, 3000–4000 GW-h of new annual production should be generated by 2010.

Main strategy measures of renewable energy of provincial and territorial governments are presented in Table 5 [37].

2.3. Strategy management of sustainable energy

In order to perform strategy management for the development of sustainable energy including energy efficiency systems and renewable energy, the Canadian government has made some regulations aimed at sustainable energy and implemented through various departments. The Canadian government departments that are participating in the strategy management for the development of sustainable energy are as follows:

2.3.1. The Natural Resources Canada

As the energy department most directly involved in REES, Natural Resources Canada has taken the lead in sustainable energy strategy and program development affecting expenditures. Natural Resources Canada has two sectors related to sustainable energy development: the Energy Policy Sector and the Energy Technology and Program Sector. The Energy Policy Sector advises the government on federal energy policies, strategies, emergency plans and activities; promotes efficient energy use; ensures development of energy sources to meet Canada's domestic needs and export opportunities. The Energy Policy Sector has the Renewable and Electrical Energy Division which oversees the federal

Table 5
Main strategy measures of renewable energy of Provincial and Territorial Governments

Measure	Measure type	Resources installed by the end of 2003 as a result of the measure
Alberta: Small Power Research and Development Act	Guaranteed price per kWh	Hydro: 48.7 MW (6.9 MW of this is also accounted for under Canadian Hydro's Renewable Energy Certificates program and the remainder, possibly, under TransAlta's renewable energy target). Wood waste: 38.5 MW (18 MW of this is also accounted for under EPCOR's Green Power ECO-PACKs and the remainder, possibly, under TransAlta's renewable energy target). Wind: 20.9 MW (18.9 MW of this is also accounted for under Canadian Hydro's Renewable Energy Certificates program and the remainder, possibly, under TransAlta's renewable energy target)
British Columbia: BC Utilities Commission Resource Planning Guidelines	Directive by regulatory authority	Wood waste: 66 MW
Ontario: "set aside" of tradable emissions allowances for renewable energy projects	Allocation of emissions allowances	Wind: 9 MW (also accounted for under the Wind Power Production Incentive and Ontario Power Generation's green power target). Hydro: 15 MW (also accounted for under Energy Ottawa's green power program)
Ontario: tax regulations package	Tax benefits	Accounted for under other programs
Prince Edward Island: PEI Energy Corporation wind power development	Construction of facility by government agency	Wind: 5.2 MW (also accounted for under Maritime Electric's Green Power program)
Québec: Fonds pour l'accroissement de l'investissement privé et la relance de l'emploi	Grants, loans and loan guarantees	Unclear whether the program contributed to the installation of any facilities
Yukon: Green Power Initiative	Construction of facility by government agency	Wind: 0.81 MW

Government's legislative, policy and regulatory responsibilities for renewable energies in Canada, and the Office of Energy Research and Development which coordinates energy R&D for the Government of Canada; administers Natural Resources Canada funding for the PERD; and acts as liaison with the International Energy Agency. The Energy Technology and Program Sector has the CANMET Energy Technology Centre and the Office of Energy Efficiency. The Office of Energy Efficiency provides policy analysis and advice on, and develops programs in support of, the efficient use of energy and the use of alternative energy and transportation fuels. The CANMET Energy Technology Centre

conducts R&D and related technology transfer activities in: efficiency technologies in the industrial and buildings sector; and vehicle and engine efficiencies; and alternative transportation fuels and renewable energy technology.

2.3.2. The Ministry of the Environment

In the Canada's cabinet, the Environment Ministry is responsible for overseeing the federal government's environment. In Canada, the Ministry of the Environment is mainly concerned with REES environmental technologies.

2.3.3. The Department of Foreign Affairs and International Development

The Department of Foreign Affairs and International Development is mainly concerned with REES as part of CDM mechanisms and opportunities.

Industry Canada: Industry Canada is mainly concerned with REES industry sectoral development.

Canada Mortgage and Housing: Canada Mortgage and Housing is mainly concerned with energy efficient housing.

3. Main issues of sustainable energy strategies in Canada

3.1. National Strategy and federal–provincial jurisdictional split

"Canada has abundant energy resources and energy potential, and has benefited greatly from competitive energy costs, supply and trade" [38]. However, Canada still faces the challenge to make a transition to sustainable energy use patterns in order to save fossil fuels for future generations and to reduce the negative impacts of burning fossil fuels on the environment. It's critical for Canada to speed the development for REES in order to meet the challenge, especially to meet the Kyoto target. The country needs to develop and implement a clear and comprehensive national strategy to speed the development for REES. Canada's federal–provincial jurisdictional conflicts are a huge barrier to developing a national strategy for energy sustainability to meet the Kyoto target because the federal government has responsibility for the international GHG commitment and needs to develop a national strategy for speeding up sustainable energy development as to achieve the commitment, while the provinces control energy policies due to the constitutional authority to regulate energy use rests mainly with the provinces. Therefore, provincial co-operation could radically speed the transition toward sustainability [39]. Fortunately, the Canadian government and all major federal political parties have made explicit plans to move toward cleaner, more renewable and efficient energy sources. Some provinces are starting to set targets or consider renewable portfolio standards and are engaged in their implementation. It is now time to develop and implement a truly national Canadian sustainable energy strategy [40].

3.2. Terminology and definitions

In theory and practice, there is, so far, no clear, comprehensive strategy framework for sustainable energy use policy in Canada. There is not even a clear definition of sustainable energy strategy. The term of sustainable energy is also confusing and inconsistently

applied. Greater clarity of definitions such as ‘‘renewable energy’’, ‘‘alternative energy’’, ‘‘green power’’, ‘‘clean power’’ and ‘‘energy efficiency’’ is required in order to develop a national strategy for energy sustainability. There must be some discussion on this issue to improve the effectiveness of desired targets and objectives. Achieving precision and agreement on terms, as means toward strategy—goals (ends) is required as policy strategy discussions continue.

3.3. Goals, thrust areas, directions and approaches

Generally speaking, the policy-strategic objectives of the development include the goals, thrust areas, directions and approach with an action plans for the development. From our analysis of the objectives of sustainable energy strategy above, we can find that the goals, thrust areas, directions and approach for sustainable energy development of the federal government of Canada are not clear, specific and identifiable and have varied. In March 2005, several non-governmental organizations from across Canada established the Canadian Renewable Energy Alliance (CanREA) to provide recommendations on the development and implementation of a National Sustainable Energy Strategy. CanREA is planning to develop a Model National Sustainable Energy Strategy. It is expected to there are clear goals, the specified thrust areas, and the identified directions and approach in the objectives of the Model National Sustainable Energy Strategy.

3.4. Energy market liberalization and strategy measures for energy sustainability

Canada is currently engaged towards an energy market liberalization process. This process of Canada mainly relies on a voluntary approach of the government. In Canada most strategy measures for REES are based on voluntary. Generally speaking, on the one hand, when subsidies tend to disappear, consumers would receive the correct price signals so that they can become interested in, and receive incentives for, the incorporation of sustainable energy. Nevertheless, it is clear that the signal that real prices represent, by making efficiency measures profitable, is not enough for the large majority of consumers who are not ready to conduct an economic analysis justifying these measures. On the other hand, voluntary measures sharply reduce the administrative costs of implementing and controlling mandatory measures and are close to industrial experience and practice. However, there is no clear argument in favour of voluntary measures for REES or mandatory measures for REES. In terms of effectiveness, there is no empirical evidence, at this stage, that such voluntary measures have been more effective than mandatory measures in open market economies, where competition is very severe [41]. But some studies indicated that mandatory measures have been very effective to improve energy efficiency in some sectors and to promote the development for some renewables technology. For example, a survey of World Energy Council found that mandatory measure for energy efficiency improvement of some specific type of equipment, which is particularly energy intensive and relies on electricity and thermal power, such as air conditioning, could be necessary [42]. In addition, the study of Lori et al. found that RPS policies or purchase mandates are the most powerful tool that a State can use to promote wind energy [43]. Therefore, governments in Canada do now seem to have begun a trend towards implementing some mandatory measures. For example, the governments of New

Brunswick, Nova Scotia, Ontario and Prince Edward Island are now close to implementing mandatory renewable portfolio standards [44].

3.5. Management efficiency strategies

As we analyzed above, the tasks of Canadian management strategies for sustainable energy development have been divided into various departments, such as The Natural Resources Canada, The Ministry of the Environment, The Department of Foreign Affairs and International Development, Industry Canada and Canada Mortgage and Housing, etc. The Canadian strategy management framework brings out a number of problems. They include overlapping functions, multi-management, decentralized funds, duplication constructions and divided policies from various sources, etc. This has weakened the ability of national intervention in the sustainable energy development and hindered the development of sustainable energy in Canada to some extent. In order to improve strategy management of sustainable energy development, there will be an increasing need for a coordinated approach and a national strategy. There is a clear need for a sustainable energy secretariat to coordinate and facilitate at a federal level and to represent Canada internationally in the growing field of sustainable energy [45].

3.6. Strategy for innovation and technological leap forward

Although they implemented some initiatives to support technology innovation for sustainable energy use systems, Canada's federal and provincial governments did little in this area comparison with other many industrialized countries. Therefore, the penetration of sustainable energy technologies, especially renewable energy technologies into the marketplace was proceeding more slowly than many other industrialized countries. According to a survey, a number of other major industrialized countries are moving rapidly to support the development and deployment of renewable energy technologies [46]. If it fails to take more effective strategy for innovation and technological leap forward, Canada would run the risk of playing a significantly less important role in devising and implementing energy options for sustainable development of the 21th century.

3.7. Fossil fuels trade and strategy for energy sustainability

Canada is a country with very rich non-renewable sources of energy and has been a net exporter of oil, gas and coal for a long time. Canada had a reported 178.8 billion barrels of proven oil reserves in 2005, second only to Saudi Arabia. In 2004, Canada produced 3.1 million barrels per day (bbl/d) and exported 0.8 million bbl/d. The proven natural gas reserves, 56.1 Tcf as of January 2005, rank 19th in the world. In 2002, Canada produced 6.6 Tcf of natural gas, the third-highest level in the world behind Russia and the United States and exported 3.6 Tcf . Canada holds an estimated 7.3 billion short tons of recoverable coal reserves and in 2002, Canada a total of 73.2 Mmst were produced and exported over half its coal production. From a long-term strategy point of view, it's very clear that the status of Canada as a net exporter of fossil fuels is unsustainable. Canada has very rich renewable energy sources including solar, wind, water, earth and biomass power, and energy from waste. It's necessary for Canada to make a long-term strategy for

exporting green power instead of fossil fuels export by accelerating the development of renewable energy.

4. Conclusion

It is critical for Canada to speed the development for REES as so to meet the Kyoto target. The development of renewable energy and energy efficiency methods requires a coherent supportive strategies framework. In theory and practice, Canada has not developed a clear, independent, integrated and entire strategy framework for energy sustainability in Canada although it has formulated various strategy measures to accelerate the development of energy efficiency systems and renewable energy technologies since 1970s. Unless it develops a national strategy framework, makes clear strategy objectives, takes more efficiency measures and improves on management strategies to speed the development for REES, Canada would fail to meet the Kyoto target.

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